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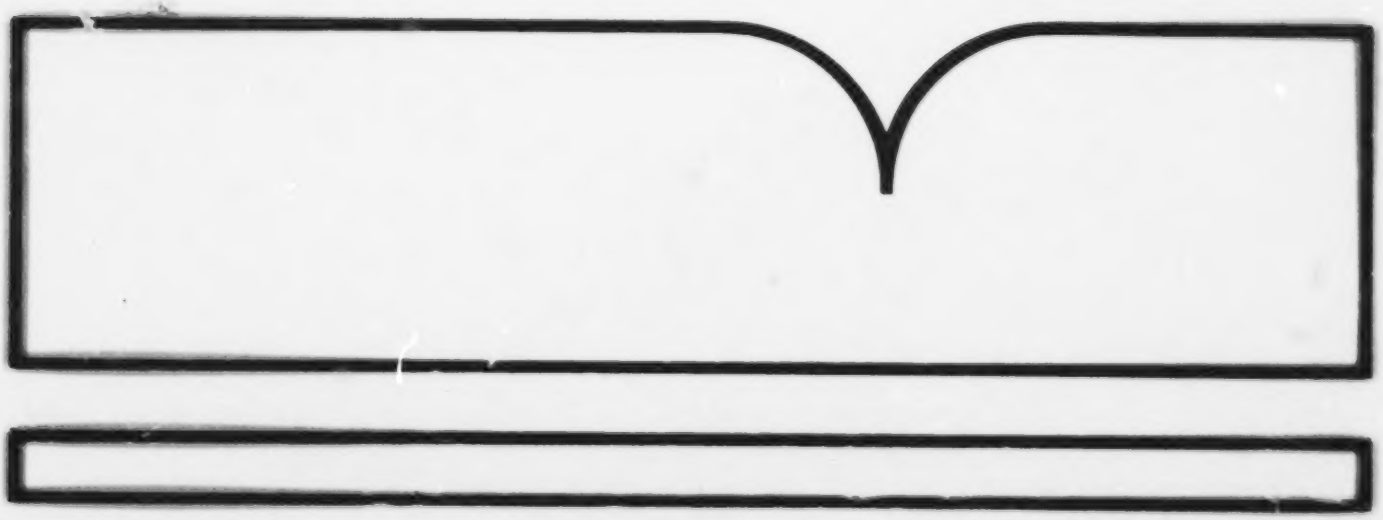

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This report is part of the National Network for Environmental Management Studies (NNEMS) done under the auspices of the Office of Cooperative Environmental Management of the United States Environmental Protection Agency (USEPA).

Solid waste is quickly becoming the primary environmental health problem on the majority of Reservations within the USEPA Region V. Sixty-six active or inactive dumps and 29 potentially hazardous waste sites are located within or near the exterior boundary of the 30 Reservations in USEPA Region V. The complexity of the Tribes' solid waste dilemma is augmented by other confounding factors. The majority of the Tribes do not have the financial means, population base, or suitable landbase to properly support approved solid waste landfills or incinerators. All the existing open dumps have management or design problems to the extent that they cannot be considered sanitary landfills.

This report discusses multiple options for the disposal of solid waste on th eTribal lands of Region V. The report includes guidelines and regulations to control and close the existing open dumps. Moreover, the report discusses environmentally sound procedures, guidelines, and regulations for sanitary landfills, incinerators, and transfer stations. Alternative means for disposing of solid hazardous wastes are identified and appropriate roles for Federal Agencies, with regard to solid waste management on Indian lands, are discussed.

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APPROPRIATE METHODS FOR CONTROL, REGULATION AND DISPOSAL OF SOLID WASTE ON TRIBAL LANDS IN EPA REGION V

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U.S.EPA REGION V

FEBRUARY 9, 1989

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APPROPRIATE METHODS FOR CONTROL, REGULATION AND DISPOSAL OF SOLID WASTE ON TRIBAL LANDS

EXECUTIVE SUMMARY

Solid waste is quickly becoming the primary environmental health problem on the majority of Reservations within the United States Environmental Protection Agency (USEPA) Region V. Sixty-six active or inactive dumps and 29 potentially hazardous waste sites are located within or near the exterior boundary of the 30 Reservations in USEPA Region V. The complexity of the Tribes' solid waste dilemma is augmented by other confounding factors. The majority of the Tribes do not have the financial means, population base, or suitable landbase to properly support approved solid waste landfills or incinerators. All the existing open dumps have management or design problems to the extent that they cannot be considered sanitary landfills.

This report discusses multiple options for the disposal of solid waste on the Tribal lands of Region V. It includes guidelines and regulations to control and close the existing open dumps and it discussed environmentally sound procedures, guidelines and regulations for sanitary landfills, incinerators and transfer stations. Alternative means for disposing of solid hazardous wastes are identified and appropriate roles for Federal Agencies, with regard to solid waste management on Indian lands are discussed.

The ultimate goals of solid waste management are to conserve natural resources and find solutions or methods of disposal which protect human health and the environment. The Tribes should encourage processes and activities that produce the lowest amount of total waste and the least amount of hazardous and nonrecyclable wastes. All reasonably feasible steps should be taken to reclaim materials form the waste stream - by reuse, recycling or reclamation of the waste to a useable product.

The 66 existing dumps on Tribal lands in USEPA Region V need to be properly closed as soon as possible. Until better alternatives are available, these dumps should be operated and maintained in an environmentally sound way. Properly sited, designed, and operated sanitary landfills and incinerators should be the final depository for Tribal wastes. Due to financial constraints, many Tribes will probably utilize transfer stations and have their wastes hauled off Reservation land.

The 29 potentially hazardous waste sites and other potentially health threatening sites found by the IHS or Tribal Health Directors should be more throughly investigated and monitored. Remedial cleanup should be done in areas where human health or the environment are threatened.

The BIA, EPA, DHUD-OIP, USGS, and IHS all have technical and financial responsibilities to the Tribes for solid waste management. These duties should be implemented by the agencies in a coordinated and responsible fashion. The alteration of the definition of Tribes as municipalities to an equal of States in

RCRA Subtitle D will promote the development of better solid waste management on Tribal lands.

Ultimately only the Tribal members can solve the solid waste management problems on their Reservations. Environmentally sound solid waste facilities are only as good as their operation. Tribal leaders should stress the financial, health, and environmental advantages of wise solid waste practices. They should focus on preventive waste measures and insist that wastes be minimized and disposed of in an environmentally sound way.

INTRODUCTION

Presently, only half as many municipal waste landfills exist as in 1979[1]. With suitable landfill space shrinking, landfill regulations tightening and tipping costs rising, solid waste management has become a critical and contentious issue for many communities, regional geographic areas, and sometimes entire states. Solid waste is also rapidly becoming the primary environmental health problem on all Reservations within the U.S. Environmental Protection Agency (EPA) Region V. Current evidence from those living within or working for these 29 Reservations indicates that unsound disposal methods such as open dumping and poorly regulated landfills commonly occur on Tribal lands[2].

In 1988 the results of an environmental needs survey[2] for Tribes of EPA Region V were published. The Council of Energy Resource Tribes (CERT) and EPA staff surveyed 21 of the 29 Tribes in Region V. Since this survey, the Miami Tribe has been recognized in Indiana which brings the number of Reservations in Region V to 30. This paper focuses on the original 29 Tribes within Region V. The remaining 8 Tribes' needs were determined from an Americans for Indian Opportunity (AIO) survey and CERT analysis. The Tribes replied that surface water quality and solid waste were the primary environmental concerns. Twenty of the 29 Tribes identified surface water quality as one of the top three priorities and 17 Tribes identified solid waste as one for the top three priorities.

Environmental problems are frequently linked with one another. When solid waste or hazardous wastes are improperly disposed of, repercussions may resurface in soil, groundwater or surface water contamination. Explosive levels of methane can accumulate in some landfills and dangerous air emissions can be produced from open air burning of solid wastes.

During the summer of 1987, another survey was done for the EPA in Region V to locate possible Superfund sites and inventory the open dumps on the 29 Indian Reservations. Sixty-six active or inactive dumps were located on or near these Reservations and 29 potentially hazardous waste sites were located within or near the exterior boundaries of these Reservations.

The complexity of the solid waste dilemma is magnified by other confounding factors. The majority of the Tribes do not have the financial means, population base, or suitable landbase to properly support approved solid waste landfills or incinerators. All the existing open dumps have management, design, or siting problems to the extent that they cannot be considered sanitary landfills. Frequently the Tribal dumps were sited in ravines (where spring meltwater and flooding can impair surface water quality) or in sandy areas (where groundwater would be more prone to contamination). Scattered roadside dumping also occurs, especially at Reservations where there is controlled or limited access to the dumpsite or where tipping fees are too high. Very few of these open or closed dump sites are being monitored for methane, groundwater or surface water contamination[3]. Arsenic, mercury, chromium, lead, and volatile organic carbon compounds (VOC) have been detected at some of the sites with monitoring

wells[4,5]. At another monitored site, no results are known by the tribe[6] although area health officials suspect there are elevated cancer rates in the people who live near the site[6].

In addition to the surface and groundwater contamination, threats posed by active and inactive dumps are explosive methane gas buildup, threats to wetlands, proliferation of disease vectors, air pollution and aesthetic degradation of the Reservations. Imminently, many Tribes face the loss of their existing disposal sites as their capacity is reached and as the revised Subtitle D landfill standards promise to exert Federal environmental regulation over Tribal dump sites. Tribes also have felt pressures from off-reservation interests that hope to site new landfills or dispose of hazardous materials on Tribal lands that are outside the regulatory jurisdiction of the states.

Presently, under the Resource Recovery and Conservation Act (RCRA) Indian Tribes are defined as municipalities, along with towns, counties and cities. This definition implies that Tribes could be subject to state jurisdiction for solid waste standards. However, in 1975, Congress passed the Indian Self-Determination and Education Act (PL93-638). Since then President Reagan issued the Federal Indian Policy of January 24, 1983, which supports the primary role of Tribal governments in matters affecting American Indian Reservations. Case laws have also repeatedly affirmed the right of Tribes to self-determination[7,8,9]. The RCRA definition of Tribes conflicts with the concept of Indian self-determination and inhibits the Tribes' entitlement to the same responsibilities and privileges that a State is afforded when a Tribe receives approval for its solid waste management plan. The Tribes also have limited access to lines of communication, regular technical assistance and guidelines when compared with the amount States have received in the past. These technical and legal problems need to be resolved quickly because solid waste problems are becoming ever more urgent.

This report outlines multiple options for the disposal of solid waste on Tribal lands. It includes a set of environmentally sound procedures, guidelines and regulations for sanitary landfills, incinerators, and transfer stations. The report emphasizes methods of waste reduction and recovery, discusses methods for hazardous waste management and identifies appropriate roles for Federal Agencies with regard to solid waste management on Indian lands.

WASTE REDUCTION, REUSE AND RECYCLING

Many areas in the United States have felt the pressures of diminishing landfill capacity and increasing costs of garbage collection and disposal. Indian Tribal lands have been primarily situated in rural locations somewhat insulated from these pressures. However, the situation is changing. Pollution problems caused by some older landfills have resulted in stricter regulation of and more opposition to landfills. Landfill construction is expensive, siting is almost impossible. Waste reduction and resource recovery can reduce the need for landfilling and reduce the potential detrimental environmental impact of landfills. Solid

waste reduction and alternatives to disposal should be the main thrusts of any solid waste plan. The amount of wastes being landfilled can be decreased by multiple techniques: 1) reduction of the quantity of waste generated 2) reuse of materials 3) recycling 4) composting and 5) recovery of energy from wastes. These approaches will be examined in more detail.

The advantages of using waste reducing methods are numerous. Landfills and dumps remove valuable land from other uses such as agriculture. They can also generate dust, litter, leachate and may cause air pollution if dumps are set on fire. Leachate, the liquid formed when the wastes decompose and water soaks through the wastes, forms at dumps and landfills. It can contain significant portions of hazardous chemicals depending on the wastes present. This can adversely effect both surface and groundwater as it can contain significant amounts of hazardous chemicals. Methane gas, formed from decomposing wastes, has the potential to build up to explosive levels and/or also damage vegetation. Landfills are expensive to construct, with new landfill fees ranging from $15 to $25 per ton in Wisconsin. Additionally, the siting of new landfills is a time consuming, expensive, frustrating and often futile process.

Waste reduction and recovery also conserves natural resources and energy. Nationally, about 20% of all used paper, 50% of aluminum cans, 50% of the nation's lead, 56% of the copper, 27% of the country's iron and steel and 5% of all glass jars and bottles are recycled[10]. Recycling saves energy and provides industries with a new source of raw materials. Often less energy is needed to produce a new product from recycled material than from virgin material[11]. Recycled materials are much more stable in price on both a percentage and an absolute value than raw materials. This benefits industry.

Finally, recycling and resource recovery can provide opportunities for collection, operations, and hauling employment. Recycling centers typically need one worker for every 400-600 tons for material recycled annually[12]. A community in Eau Claire County, Wisconsin utilizes a unique labor force for its Western Dairyland Recycling Center. There are a few paid staff, but beyond that the recycling center functions as the county's largest worksite for general relief recipients. Non-violent adolescent and adult offenders do community service work there as an alternative to jail, a scout troop volunteers there and the center serves as a worksite for a low-income youth employment program during summer months and as a job skills training site for a federal employment training center[13]. The Winnebago Tribe plans to use Indian Relief workers to help the their proposed recycling center[14].

Presently, only Forest County Potowatami (WI) and Leech Lake (MN) Reservations have recycling programs; however, many other Reservations have expressed a desire to begin a waste reduction and recycling program. Through the use of outreach and educational programs, an integrated approach to conservation, recovery and disposal of solid and household hazardous wastes could be developed on the Reservations. The Department of Natural Resources in each State has an extensive set of public information publications on these topics. All practical alternatives should be considered,

giving priority to practices that produce the greatest environmental and economic benefits.

Waste or source reduction follows the philosophy that some items which become solid waste should never be manufactured and other products commonly discarded should contain fewer materials and no hazardous/toxic compoments (ie. mercury batteries) or have a longer product life. About 50% of the paper, 8% of the steel, 75% of the glass, 40% of the aluminum and 30% of the total plastics in this country are used solely to package or decorate consumer products[15]. One out of every $11 spent on groceries goes for packaging, and containers and packaging account for 33% of the total waste stream. Reusing bags and boxes can reduce the need for extra packaging materials. An increased product lifetime of consumer durables such as appliances, televisions, radios, furniture, and tires would also decrease the amount of solid waste. One can aid in this area by buying durable items with longer warrenties and by repairing and maintaining the items one owns. Efforts should be made to substitute for and thus eliminate products that 1) cannot be recycled or 2) produce or need in their production hazardous materials (ie. polyvinyl chloride plastics).

Waste reuse involves switching from single-use products to multiple-use items (ie. rechargeable batteries) as well as repairing items for reuse. Reusing cardboard boxes, paper bags, plastic plates and cutlery, and finding a secondary uses for products such as tire swings can reduce wastes. Outgrown clothes, broken furniture and old appliances can be rejuvenated and reused by such charitable organizations as Goodwill Industries, Rescue Missions or church groups. Garage sales and second-hand stores would also help to extend the product lifetimes.

Recycling consists of the mechanical or manual separation of waste into components that can be chemically or physically reformulated into new products. While recycling cannot totally eliminate a community's need for a sanitary landfill, a well run recycling program can significantly reduce the volume of wastes that must be landfilled. A variety of recycling approaches can be used. The best approach depends on the geographic area, the population and the degree of community support. For most people recycling is a new activity and must be learned and encouraged. A continuous educational promotional campaign will probably be necessary to ensure public knowledge and involvement in recycling on the Reservation.

A drop-off center is an easy method which requires low capital investment. The center can be as simple as placement of unattended containers to 'drop-off' recyclable materials, and the center could be a satellite site of a larger central facility where the processing and marketing could be done. Although these centers generally have lower participation rates than other methods, some Wisconsin communities have achieved over an 80% reduction in landfill needs[16].

Buy-back centers usually draw more community involvement because the center pays people to bring in recyclable materials, usually newspaper, glass and aluminum cans. Buy-back centers normally collect only the most economically lucrative components of

the solid waste stream. Thus, its overall impact may be diminished especially when the prices decline.

Curbside pick-up generally produces the greatest community response because of the ease of participation, especially if it is the same day as regular solid waste pick-up. This approach requires consistent participation to be cost effective and provide cinsistent quantities of materials to market.

Prairie du Sac, Wisconsin, with a population of 2,200, has a mandatory curbside program with virtually 100% participation. In Pennsylvania, proposed legistation encourages recycling by providing state grants to communities for each ton of material recycled[17]. The subsidized program paid participating municipalities one-half of the avoided disposal cost. With this program, the recycling efforts produced profits of approximately $26.80 for each ton of material recycled.

Community involvement is the key for a long-term successful program. The Tribe may want to run a recycling-reuse center as a Tribal enterprise to gather full support. Recycling growth is usually limited by demand rather than supply. Frequently, the most troublesome aspect of a recycling program is market development. An intermediate broker, who buys and sells scrap material may be necessary in small communities where only limited amounts of recyclable materials are produced. A community should attempt to estimate the volumes and types of wastes it plans to recycle, then consult with the State Department of Natural Resources about recycling markets and other recycling centers.

The best markets are frequently those closest to the recycling center because of transportation costs. In Shawano, Wisconsin a family-run recycling center shreds and bales paper products. Dairy farmers buy the paper bales for $2.50 per bale for use as animal bedding[18]. It is preferable to straw because it is dust-free, durable, soft, and less attractive to flies. Office waste paper is also separated by grades and sold up to $150 per ton by this center. Another Wisconsin recycling center (Eau Claire) sells its newspapers to a local insulation firm for cellulose insulation[19]. Local market opportunities may need to be developed in areas where the Tribes are located, but need not be "traditional" markets.

Composting fish, food and yard wastes can easily be done in one's backyard. The humus that is produced can be added to flower or vegetable gardens to enrich the soil and improve the soil's physical properties. This process takes a minimum amount of effort, helps reduce solid wastes and creates a beneficial by-product that can be used by the family. Finally, there are multiple methods by which solid waste can be burned to generate energy. These methods will be discussed in a later section (Incineration) of this report.

Waste reduction and resource recovery methods can lead to lowering landfill costs, extending the landfill's life, saving resources, reducing litter, creating jobs and developing an environmental ethic in the community. Participants become aware of each individual's role in waste management and their efforts help provide environmental protection of air and water on the Reservation. These programs promote positive action for and pride

in one's community and Reservation. These methods should be the primary goals of each Reservation's solid waste plan.

NON-HAZARDOUS WASTE MANAGEMENT

INTRODUCTION

Currently there are 66 known open dumps on Tribal lands within EPA Region V. Many dumps have uncontrolled open air burning to reduce waste volume despite the ban on open burning since 1979 and are unmanaged, improperly sited, have no groundwater monitoring, and have extremely poor accounts receivable records[20,21]. Groundwater contamination with volatile organic compounds and heavy metals have been caused by some of these dumps. Scattered roadside dumping occurs on many of the Reservations primarily because of limited access to the dumps or dump fees.

Environmentally sound solid waste plans need to be developed for each of the 30 Reservations in USEPA Region V. Until they are developed, stricter operational requirements for the present dumps and proper closure of these dumps should be established and implemented. Currently, due to the financial constraints and shortages of technical and managerial staffing of most Tribes in this region, the majority of the Tribal Environmental Directors or Sanitarians (usually from the Indian Health Service) prefer to develop plans to have their wastes transported off the Reservation[22]. However, the transfer of solid wastes is not a final solution to solid waste disposal. Tribal members may ultimately have to participate in county, regional or private plans for solid waste disposal. Incinerators and sanitary landfills will have to be constructed in future years and may possibly be best sited on Tribal lands in some areas. Thus, it is important for Tribal members to concern themselves with not only immediate remedial action for present open dumps, but also with long range planning for transfer stations, sanitary landfills and incinerators which will also environmentally and financially affect the Reservations.

The following section outlines guidelines and regulations to control and close existing open dumps. It also includes alternative procedures, guidelines and regulations for developing sanitary landfills, incinerators, and transfer stations. The advantages and disadvantages associated with each method will also be discussed.

EXISTING DUMPS

The majority of the existing open dumps are improperly sited with no soil borings or groundwater studies done to determine the adequacy of the sites[23]. Some are located in wetlands, ravines, gravel pits, and sandy outwash areas. No long term plans were made for future expansion, none have liners or leachate collection systems, and few are monitored. There is frequent open-air burning. Eventually all of these sites should be closed, but until alternatives are developed, some may need to remain operational.

Despite the less than adequate facilities, efforts should be made to ensure that the most efficient, nuisance-free, and environmentally acceptable procedures are used at these existing dumps.

Access to the facility should be restricted through use of gates, fences or natural barriers. A sign should be posted at the entrance which indicates the facility name, hours of operation, types of waste accepted and penalties for unauthorized use. An attendant should be on duty at the facility when it is open for public use. The gate area should be policed at the beginning of each day of operation to remove any solid waste which has been dumped during closed hours. Penalities should be issued for gate and roadside dumping. Access roads to the dump should be of all-weather construction and should be maintained.

Tree or fencing windbreaks will help to confine dust and litter to within the active disposal area. Scavenging within the active disposal area should be prohibited. Open burning should not be permitted because it can create air pollution problems, can damage property, and it can be a threat to public safty. To control accidental fires, arrangements should be made with the local fire protection agency or fire control equipment should be present.

No car batteries, paints, solvents, chemical waste, toxic (ie. pesticide) or other hazardous, infectious, or radioactive wastes should be accepted at the dump. If asbestos is accepted, special handling procedures must be employed. The asbestos should be disposed of at the base of the active working area, then it should be immediately covered with a minimum of 3 feet of waste or soil prior to compaction. No free liquid wastes or non-free liquid solid wastes (ie. sludge) should be accepted at the facility since the majority of these existing dumps are improperly sited and designed. If the open dump is found to be properly sited, then small quantities may possibly be accepted. The generator should use a paint filter liquids test for the sludge [24], and the sludge should pass the test before it is accepted in large quantities. Free liquids and sludges should be mixed with absorbants such as soil, sawdust, or cement kiln dust before their disposal.

The daily deposition of solid waste should be confined to as small an area as possible. All windblown material should be collected and properly contained in the active area. The waste should be compacted and covered with about 6 inches of compacted soil daily. Putrescible material such as spoiled foods and animal carcasses should be immediately compacted and covered to help control flies, other insects and vermin. Compacted soil layers should be scarified prior to the next waste deposition or perching of the leachate may develop.

Finally, at all these existing sites an environmental analysis and general monitoring program should be required. Information on the soil and bedrock characteristics and a water table map that shows the horizontal and vertical hydraulic gradients should be researched and compiled. Undisturbed soil samples should be taken to measure particle size, Atterberg limits, texture and color. The geologic origin, structure, mottling, moisture, layering, jointing, fractures, porosity, in-situ hydraulic conductivity and

classification of the soil and bedrock should be evaluated from boring logs and field tests. Monitoring wells should be installed for groundwater sampling. The monitoring wells should have caps to prevent contaminants from entering the monitoring well and should additionally have protective metal casings and locking lids. Care should be employed to properly install monitoring wells and only high quality well construction materials (including glues) should be used so that metals and organic compounds can be accurately analysed. Inadequate well materials or well security can completely nullify well reliability as it has on some Tribal land monitoring wells[25,26]. Background water quality should be checked up gradient from the dump. Groundwater monitoring wells should be installed and maintained so that reliable and representative information regarding aquifer characteristics, groundwater flow directions and physical and chemical characteristics of the groundwater can be obtained. Methane gas, surface water and air monitoring may also be necessary at the site. These monitoring divices should be sampled at least semiannually. The number of monitoring points required and the frequency of the sampling should be based on the dump size, waste types, facility design and hydrogeologic and geologic setting of the dump. If evidence of groundwater contamination is found, then more monitoring or clean up may be necessary.

All sampling and analysis procedures should be standardized and run by a certified laboratory. Groundwater level elevation should be measured and recorded at the sites. Wells should be purged prior to sampling and the physical appearance of the water sample including color, odor, and turbidity should be noted. There are various tests that can be run on groundwater samples. These include: field conductivity, field pH, alkalinity, COD, hardness, chlorine, copper, dissolved iron, sulfate, total dissolved solids, zinc, volatile organic compounds, arsenic, barium, cadmium, lead, mercury, nitrates, and chromium. Depending upon the history of the dump site and the suspected wastes dumped there, initially field conductivity, field pH, alkalinity, COD, hardness, chlorine, total dissolved solids, several volatile organic compounds, and perhaps several suspected metals should be examined.

Some volatile organic compounds (VOC) appear to be ubiquitious in municipal solid waste leachate[27]. These include: toluene, methylene chloride, 1,1,2-trichloroethylene, 1,1-dichloroethane, ethylbenzene, benzene, and trans-1,1-dichloroethylene. Typically, these compounds are solvents with household or industrial uses. They are relatively mobile in most soils under varying pH and redox conditions since normal attenuation mechanisms are ineffective. Organic compounds do not form precipitates with naturally occurring ions. Furthermore, chlorinated organics are resistant to biodegradation and physical sorption is very limited. Many of these volatile organic compounds can have serious health effects at very low levels[28]. Generally, the choice of parameters measured at dumps and landfills is based upon selection of those parameters which will serve as indicators of contamination from the waste types disposed at a site. These tend to include only pH, conductivity, chloride, COD, iron, sulfate and nitrate. Historically, little emphasis has been placed on choosing

parameters for their significance to human health or the environment. Landfills, and especially old landfills and dumps, contain a wide variety of wastes and many unknowns that may represent possible health risks. Thus, volatile organic compounds, because of their mobility in many soil types, ubiquitous nature in solid waste leachates and ease of analytical detection, may prove to be useful indicators of solid waste leachate contamination. Sabel and Clark [29] noted that when solid waste leachate contaminated surface water in Minnesota, VOC were not detected in the rapidly flowing creek water in the summer, but were detected beneath the ice in winter. This may have implications for both aquatic life and ice-fishermen on some of the Tribal lands.

If groundwater or well contamination is detected at existing dumps, monitoring should be intensified. In areas where human health is threatened, remedial action may be necessary. Initially, such a site should be closed and capped so that the amount of new leachate is limited. The landfill should be analysed to determine if locations exist where leachate could be extracted. Pumping wells should be used to extract the contaminated leachate. If an impervious underlying strata exists, and the health dangers counterbalance the costs, then further remedial actions are possible. Addition of soil-bentonite slurry walls can help to contain leachate and act as a barrier to prevent lateral migration of underground fluids. Typically a continuous, 36 inch wide trench is excavated with a backhoe to a relatively impervious underlying strata. A bentonite slurry is mixed with the excavated soil and backfilled in a sequence that avoids the creation of voids in the slurry wall[30]. This soil-bentonite cutoff wall technique may be the most efficient, adaptive and cost-effective remedial action for some sites. Other highly contaminated sites which threaten human health may need remedial actions such as removal, bioreclamation, chemical treatment, or solidification of the wastes.

Eventually, all 66 open dumps in USEPA Region V will be closed. Presently, dump closure is unsupervised[31] and frequently it is inadequate. The Old Oneida Dump site, closed in the early 1970's, was covered with only 3-4 inches of sand in some areas and it has old trash exposed at the surface[32].

A closure plan should be developed for each dump site. It should identify and define the following: location by quarter section, township, range, town, and county; final limits of the waste placement, well and other monitoring locations, locations of nearby public and private water supply wells, a water table map with horizontal and vertical gradients at the facility, surface water drainage patterns, all monitoring data, the waste types and quantities disposed and the operators and operational dates.

The closure itself should be supervised by the Tribal Health Director and an Indian Health Service official. Closure activities should minimize the need for further maintenance and minimize the formation and relaease of leachate and explosive gases. In the state of Wisconsin the entire closure area is covered with at least 2 feet of compacted earth that has a very low hydraulic conductivity and is adequately sloped to allow surface water runoff (>2% but than a 3 horizontal to 1 vertical slope). The surface runoff is diverted to limit the potential erosion of the soil

cover. The finished surface is then covered with a minumum of 1.5 feet of noncompacted topsoil and seeded within 3 months with something compatible to both the natural vegetation and the final use. This area is mulched and periodically rechecked and perhaps reseeded if necessary to ensure adequate revegetation.

Semiannual long-term post-closure monitoring should continue for surface and/or groundwater, leachate and gas production. Groundwater problems may only appear years after the dump sites has closed. The final use of closed dump sites should be regulated. Such sites should not allow excavation of final cover or wastes, establishment of buildings, or agriculture unless more extensive safety tests are made.

Due to the financial constraints of many Reservations in USEPA Region V, many of these inadequate open dumps must remain operational until new, more environmentally sound solid waste management plans can be established and implemented. Until that time, use of these procedures, guidelines and regulations will help curtail environmental problems during their remaining operation and closure.

SANITARY LANDFILLS

A primary objective in the design of sanitary landfills or secure hazardous waste disposal sites is the protection of groundwater quality. No single landfill design can fit all regional existing site conditions. Sanitary landfills are appropriately sited, and designed for the specific set of hydrologic, geologic and pedologic properties of the site. With the increased federal and state requirements for solid waste facilities, small sites are no longer economical. A sparsely populated area may not have enough waste to pay for the landfill expenses, for example the town of Lac du Flambeau, Wisconsin wanted a small sized landfill and discovered the tipping fee would amount to approximately $100 per ton because of the long haul distance for the clay needed to line the site[33]. Other larger landfills have tipping fees in the range of $10-30 per ton.

The siting of a sanitary landfill may take 4-5 years to accomplish and cost several million dollars. For most Tribes, involvement in county or regional or private landfills may be the most economically feasible approach. It is important for Tribal members to understand the basics of the siting, design, operation and closure of sanitary landfills. Environmental pollution knows no Tribal land boundaries. A poorly sited or inadequately designed or operated landfill 30 miles from the Reservation may still adversely affect Tribal lands.

In selecting a site, it is necessary to consider: public opinion, environmental impact, hauling distance, and zoning. An initial site report and feasibility report should be developed. Each State has guidelines of what typically should be included in a feasibility report. A feasibility report generally requires information on: land use, expected waste types and volumes, facility location and acreage, proposed facility life, design capacity, estimated date on initial operation, adjacent land owners, land use zoning, proposed transportation and access roads,

and regional geotechnical information. The regional geotechnical information would include data on topography, hydrology, geologic setting, hydrogeology and water quality. Specific laboratory and field investigations from borings and wells are necessary to define the physical characteristics of the facility (ie. soils, bedrock and groundwater). Watertable maps, geologic cross sections, and a water budget should be prepared. The anticipated waste and leachate should be characterized and the proposed clay barrow source for the facility's liner and cap should be identified.

Based on the information obtained, a proposed design is developed which considers the combined design restraints. An evaluation to justify the need for the landfill should be included along with an estimate of the costs, an environmental assessment summary and a discussion of possible waste reduction and recycling measures. Public participation such as public hearings, advisory committees, news releases and tours must be components of the siting process.

The proper design of a sanitary landfill must ensure long term environmental protection and a cost-effective utilization of manpower, equipment and space. Every site selected for a landfill ordinarily has characteristics that make it less than ideal. When possible, engineering techniques may be used to surmount site limitations and thus meet design and performance goals. The data collected for feasibility reports and the siting process should be used to develop the design, but additional and more detailed information may be needed. Severe groundwater contamination was partially caused at several engineered landfills in Wisconsin when moderately fractured dolomite, joints in glacial till and lacustrine deposits, and buried beach ridges were not identified during the site investigations[34].

Special location restrictions should be enforced for landfills in the vicinity of airports, floodpains, wetlands, and unstable areas such as subsidence-prone areas, areas susceptible to mass movement, weak and unstable soils, and Karst terrains (areas where solution cavities and caverns develop in limestone or dolomitic materials). A set of performance standards should be established to deter detrimental effects on: surface and groundwater, critical habitats, wetlands, and to control explosive gas concentration and hazardous air emissions.

A minimum design criteria should also be established for specific design, leachate containment and collection, gas control, runoff control, design capacity, and closure. Each of these criteria will be discussed.

It is a commonly accepted design practice to locate landfills in areas of natural clay deposits whenever possible. In most areas of USEPA Region V natural clay deposits are not present (ie. sandy and gravelly sites). Acceptable modification of an otherwise geologically or pedologically unsuitable site is made by installing clay-lined landfills with leachate collection systems. The clay liner should have a minimum thickness of 3-5 feet. The minimum slope on the top of this liner toward the leachate collection lines should be at least 2 percent. A minimum one foot thick granular drainage blanket should be placed on top of the clay-lined base and sidewalls. Both the clay liner and granular drainage blanket

should have specific particle size and hydraulic conductivity requirements. The clay liner could be on the thinner end of the scale if the drainage blanket has excellent hydraulic characteristics. It should be noted that the hydraulic conductivity tests used for siting landfills, clay liners and drainage blankets are extremely variable. Both laboratory and field testing methods are used. Most average lab values are at least one order of magnitude lower than the field test results[35]. Research indicates that field tests should be used as the primary method for determining hydraulic conductivity for landfills. The sidewalls should not exeed a 3 horizontal to 1 vertical slope. A minimum distance of 10 feet should separate the bottom of the clay liner from both the seasonal high groundwater table and the competent bedrock distance. The clay liner should form a continuous seal. Geosynthetic liners can also be employed as an option to control leachate movement. These liners can be used as a single liner for Class D landfills.

The capacity of these landfills should be planned so that a minimum of ten years of the expected volume of solid waste and cover can be handled. The maximum design capacity should not exceed the expected volume of waste and cover that would be disposed of within about 20 years after operations begin. This maximum limit allows more flexibility if the waste trends or technology changes.

The leachate collection systems for both landfill types should incorporate specific design features such as 0.5% minimum slope and 6 inch minimum diameter pipe. This pipe should be placed within a gravel bed or geotextile of a specific thickness and texture. This latter requirement reduces the potential for sludge and fine-grained soil from clogging the leachate collection pipes.

Restrictions on clay daily covers or volume of sludge wastes accepted may be necessary for some site operations. Leachate collection line spacing, cleanout access points, flow valves, collection tanks and other specific criteria should also have guidelines. Analytical models have been developed to evaluate the collection efficiency of clay-lined landfills[36]. These models may be useful in specific designing of sites. Most landfill leachate is sent to and treated at municipal wastewater treatment facilities[37]. Studies have shown that air supply, oxygen transfer capacity, and nutrient concentrations may have to be regulated at municipal wastewater plants that handle solid waste leachate because of the increased organic loads[38].

All landfill facilities accepting wastes with the potential to generate explosive gases should be engineered to control gas migration. Typically landfill gases are composed of about 47% methane, 47% carbon dioxide and some toxic gases such as benzene, toluene, zylenes and vinyl chloride[39]. Methane gas migrates through soils and may accumulate in buildings. If concentrations exceed 5%, the lower explosive limit, there is a danger of a methane gas explosion. Methane gas can also kill vegetation by displacing the oxygen in soils. Both passive gas venting pipes or gravelfilled trenches and active vacuum pump systems can be installed depending on the risk of methane accumulation in buildings. At some landfills, it is cost effective to install gas

recovery wells throughout the landfill for its energy value. If a methane gas energy recovery system is going to be employed, modified landfill operation techniques exist that enhance gas production[40]. However, the methane gas from landfills is both moist and impure. These impurities some of which are toxic, can cause engine problems[41]. A series of gas monitoring probes should be designed outside the limits of the waste fill on all sides of the landfill and at least one set of gas probes should be designed at the elevation of the base of the landfill. The amount of methane gas generated from landfills can vary considerably over time, and soil and weather conditions such as barometric pressure and soil moisture conditions can greatly effect the rate of gas migration. Typically methane gas monitoring probes are measured every three months. This infrequent sampling can sometimes provide misleading results[42]. The state of Wisconsin therefore requires that the concentration of methane in the soils or air at the property boundary should not exceed 25% of the lower explosive limit at any time, although the Federal regulations are less stringent and require that the concentration not exceed 100% of the lower explosive limit at the property boundary.

Rainfall runoff should be diverted away from the active fill area and any clay borrow areas. Drainage ditches, structures and sedimentation basins should be installed where necessary during the initial stages of construction to minimize erosion, sedimentation and flooding. A runoff analysis should be done to aid in designing these features. There are other requirements that should be incorporated into the design such as dust and windblown debris control, access restrictions and access road design. An adequate separation distance should be maintained between the limits of waste filling and adjacent property lines. The landfill should be disigned so that the final grades in each phase can be reached as soon as possible and the active dumping area is kept to a minumum.

The final closure and cover should be designed to minimize leachate generation by limiting the amount of percolation through the cap system. Slope and texture of the cap should be specified in the design plan. This cover should also minimize the need for further maintenance. The final cap should be protected from erosion by a vegetative cover and from freeze-thaw and desiccation. In the northern United States, soil surfaces including landfill covers can experience freezing to depths of 2 meters or more. Due to tensile stresses, frost cracks can develop in landfill covers[43].

The State of Wisconsin, because of the frigid temperature regimes within the State boundaries, requires that landfill covers consist of a 2 foot thick clay cap which impedes percolation and a 1.5 to 2.5 thick sandy or loamy layer above this that will buffer the clay cap from freezing and desiccation and will provide additional root growth area. At the surface of this buffer, 6 inches of topsoil should be depositied and seeded with something compatable to the natural vegetation and the final land use.

As with closed existing landfills, the varieties of final land use should be limited. Subsidence, explosive gas production and corrosion on building materials hinder building on landfill sites; although successful redevelopment on such sites has occurred[44].

Recreation areas, wildlife areas, golf courses, parking lots, tennis courts or parks are good uses for old landfill sites.

A gas venting, leachate collection system and monitoring wells should be in place and used and checked in a prescribed timely manner. The operation of a sanitary landfill would vary from site to site, but would generally follow the basic guidelines outlined in this report for existing dumps. At larger sites, tighter regulations on waste placement should be required. State solid waste personel can give guidance to the Tribes for all details of solid waste management.

Waste reduction and recovery methods should always be the primary goals of any waste management plan. Reuse, recycling, composting and production of recoverable products should be strongly promoted. Landfills do play a vital role in waste management in that well-designed sanitary sites can safely contain non-recoverable solid wastes. Gas venting, leachate collection systems, daily covers, and capping can all minimize the adverse affects landfills can have on the environment. However, landfills still represent a loss of raw materials, landuse options, property values and money.

INCINERATION

In recent years, tighter regulations, higher costs, and mounting opposition to landfills have made it more difficult to site new sanitary landfills. Even though landfilling wastes remains the least expensive waste management option, many urban areas, industries and some moderate sized communities are considering municipal waste incineration facilities. Some garbage haulers are also supporting waste incineration because it insures them a more stable future[45]. To retain control of their business, haulers have to be sure they have a disposal site at a reasonable transport distance.

Presently, there are 134 waste incineration facilities operating in the United States in 1988. Thirty-eight of these facilities only reduce waste, the rest both reduce and derive energy from the waste[46]. Most of the waste-reduction-only facilities were built before 1975. The majority of the waste-to-energy facilities are located along the eastern seaboard of the United States where population is more dense and landfill space is the least available. Only 12 of these waste incineration facilities are located in USEPA Region V[47]. As of 1989, approximately 16.0% (post-recycling) of the total solid waste in the United States will be incinerated. This compares with 68% for Japan[48] and 56% for Sweden[49].

There exists three main kinds of facilities used to incinerate solid municipal wastes. These are modular, mass burn and refuse-derived fuel (RDF) facilities. Each of these systems has its advantages and disadvantages.

Modular incinerators are typically factory-fabricated field erected facilities that are best suited to small waste flows (5-400 tons per day). Originally, these facilities were relatively less expensive than the other types of incinerators because of the limited need for onsite construction[50]. However, the costs of

these plants has increased dramatically because of more stringent air pollution regulation; presently these plants cost approximately the same per ton as larger plants[51]. Typically the nonprocessed waste is dumped onto the receiving area floor, then moved by conveyor to the incinerator and into it by a mechanical-ram system, moving grates, rotary chambers or a rotary auger. There are two basic combustion processes used in small scale systems, the starved air and the excessive air processes. The starved air system consists of two or more chambers where the primary chamber is operated in an oxygen deficient condition to reduce gas velocities and thus the amount of entrained air pollutants. The secondary chamber has excess air conditions to complete the combustion of the partially burned compounds. The excess air process for modular incinerators is just a scaled down version of the conventional large scale systems.

The mass burn incinerators have a much larger capacity (50-3000 tons per day) than modular units. Mass burn facilities combust the waste without any preprocessing other than removal of oversized items such as refrigerators. A large concrete pit receives and stores several day's supply of waste for these plants should operate continuously. A large overhead crane mixes and feeds the waste into an excess air furnace. Here the waste moves down a series of grates or inclines where excessive combustion air is supplied to promote complete mixing and combustion of gases. The boiler system is either the preferred waterwall or older convection type unit (used with a refractory lined furnace). In both boiler systems, the boiler water is converted to steam which removes energy from the furnace air. The produced steam is used directly for heating or energy production.

The third type of incineration facility is the refuse-derived-fuel design (RDF). RDF is a new technology, its development did not begin until the late 1960's. This American design incorporates a series of shredders, screens, and density classifiers to shred and separate the burnable fraction of the incoming waste. This presorting can lead to the recovery of aluminum, glass and ferrous materals but this method would probably not promote paper or plastic recovery. The resulting materials composed of both cellulose (paper and wood) and organics (plastics and food wastes) produce a higher Btu, more readily burnable fuel. RDF has the advantage of potential diversity as a fuel source. It can be burned in existing electricity utility burners in combination with coal and thereby eliminate the expense of designing and constructing a special facility. It can also be burned in dedicated boilers designed specifically for RDF combustion.

Currently, the capital costs for waste-to-energy facilities run approximately $100,000 per ton, with no apparent economies of scale advantage for larger facilities. Significant variations in capital costs exist ($70,000 per ton for a 1000 ton per day (TPD) facility to $130,000 per ton for a 2250 TPD facility) and tipping fees are also variable ($18 to $90 per ton)[52,53]. These cost variations are due to differences in the labor market, design requirements, vendor design criteria, the deal negotiated, the tax laws, and financing.

Presently, Colmac Energy, Incorporated is planning to build an electric power plant on the Cabazon Band of Mission Indians Reservation Section VI in Mecca, Riverside County, California. Two fluidized bed combustors will burn agricultural biomass, municipal maintenance woody residues, and commercial and industrial wood residues. The plant is expected to generate a maximum of 49 megawatts of power for distribution to the Southern California Edison grid system. Colmac Energy Inc., will lease approximately 104 acres from the Tribe; however, the project has been delayed due to concern from the surrounding communities about air emissions from the plant[54].

It is unlikely that a Tribe would desire to construct its own municipal waste incinerator due to costs. However, in areas where the geology, soils or hydrogeology would inhibit the development of a sanitary landfill, a county or regional waste-to-energy incinerator may be feasible. Such a facility would require location, operation, and performance regulations. The location standards should be similar to those detailed in this report for sanitary landfills with respect to lakes, rivers, floodplains, wells, highways and airports. The facility should be designed and operated to control emissions of odors, dust, gases, contaminants and particulate matter. Unacceptable material such as hazardous waste, asbestos and explosive materials should be screened from incoming wastes. Permanent records should be maintained of amounts of material incinerated, combustion temperature, residence time, bottom and flyash characterization and air emission monitoring data. An approved alternative method of solid waste disposal should also be developed for use during the incineration downtime.

The performance regulations for municipal waste incinerators should also be similar to those proposed in this report for sanitary landfills. Incinerators should not create adverse impacts on wetlands, critical habitat areas, surface or groundwater quality, or air quality. Incinerators, because the combustion process, produce air emissions, fly ash and bottom ash, and thus need additional performance regulations. These outputs create some environmental problems unique to incineration disposal of solid waste.

In 1977 amendments to the Clean Air Act (CAA) were passed by Congress. This established the Prevention of Significant Deterioration (PSD) program which was designed in part to prevent the flight of industry from severely polluted areas of the country where control technology requirements are very stringent. Under the PSD program, Best Available Control Technology (BACT) is required on major sources and major modifications of existing sources. This is an emission limitation based on the maximum degree of reduction of each pollutant subject to regulation under the CAA which would be emitted from the facility. The facilities are permitted on a case-by-case basis, taking into account energy, environmental and economic impacts and other costs. Each facility must apply production processes and available methods, systems and technologies, including fuel cleaning or treatment or innovative fuel conbustion techniques for control of each such pollutant[55]. BACT ultimately determines the emissions from a source that causes air quality related impacts, thus it provides the majority of the

input data for the air quality analysis, and it may provide the applicant with information to base corporate decisions concerning possible control strategies and the public with environmental information. BACT is determined on a case-to-case basis, so that the same type of facilities may not have identical emission limits in one area of the country as another. However, BACT determinations are still consistent from one area to another in that a consistent approach is used in the determination of BACT and the impacts of alternative emission control systems are measured by the same set of parameters.

The Federal PSD regulations are contained in 40 CRF 52.21. States may obtain Federal approval of their own PSD regulations based on criteria contained in 40 CRF part 51. Concern about the growth of incineration as a waste disposal option prompted the USEPA to issue an Operational Guidance memorandum on control technology for new and modified municipal waste conbustors[56]. This guidance aids in the reduction of delay and confusion in the permitting process and was based on a comprehensive study of municipal waste conbustion done by the Agency in 1987. However, continued concern about emissions control of new incinerators has resulted in several PSD permits being appealed to the USEPA Administrator under the provisions of 40CFR 124.19, since this Operational Guidance memorandum. Newly revised USEPA air emission standards for new municipal waste incineration facilities are expected to be proposed in November 1989[57]. The Agency is also preparing new guidelines for the retrofit of existing facilities. The air emissions from solid waste incinerators usually include particulates, sulfur dioxide, oxides of nitrogen, heavy metals and partially combusted organic chemicals[58]. Significant quantities of a number of different mercury compounds were being emitted into the air in many industrialized countries through incineration of municipal wastes[59,60,61]. The water soluble mercury compounds were accumulating in humic layers and lake sediments which led to high mercury concertration in certain kinds of fish. Fifty percent of the total mercury content in municipal waste incineration was due to used batteries. Paints, thermometers, electronic components and fluorescent tubes were also mercury sources. It does not appear feasible to remove the small mercury-containing batteries from the as-delivered trash at incineration facilities[62]. However, if batteries are removed from the waste stream by the consumer, mercury emissions can be significantly reduced. Eighty to ninety percent of the remaining mercury can be bound up in the fly ash with the aid of wet scrubbers or an electrostatic precipitator and fabric filter bags when the system is under proper temperatures and pH.

Relatively high emissions of dioxins, furans, mutagenic substances and other trace organics have been linked to municipal waste incineration[63,64]. A moratorium was imposed on municipal waste incinerator construction when high levels of dioxin in fish and mothers' milk were discovered in Sweden[65]. These substances are frequently environmentally persistent and can have severe health impacts[66]. Technical measures to optimize the combustion efficiency and new flue gas technologies have since substantially reduced the amount of mercury, dust, carbon monoxide and these

hazardous organic compounds. The Swedish moratorium has ended and strict air emission standards and continuous emissions monitoring were adopted.

With more effective air pollution controls, some pollutants such as heavy metals are simply moved from one medium (air) to another (flyash). Major emphasis should be given to keep potentially hazardous items out of the incineration process. Such items would include, lead-acid and nickel cadmium batteries, inks, paints, metallic coatings, galvanized products and solder. Substitution of less toxic materials for product manufacturing should be pursued wherever feasible. Organics such as dioxins and furans are also found in the incinerator ash. The elimination of chlorine-containing polyvinyl chloride plastic products and bleached paper products would help to reduce these toxic organics which need chlorine for their formation.

Incineration is not a complete alternative to landfills, although it does reduce both the volume of the waste by 60% to 90% and the weight of the waste by 25%[67]. All solid waste incineration systems produce fly ash and bottom ash and some systems also produce wastewater. Bottom ash (slag) is the residual material that drops from the bottom of the incinerator at the end of the burning cycle. For modular or massburn incinerators, it constitutes about 85% to 99% of the total ash, but in RDF facilities it may be only 25% to 50% of the total ash[68,69]. Flyash is the lighter particles entrained in the combustion gases and collected by the air pollution control equipment. Inorganic constituents such as cadmium, lead, mercury, arsenic, and chlorides are considerably more concentrated in the smaller flyash particles and more frequently test as hazardous waste than bottom ash[70,71]. Iron, copper and lead are mainly discharged in the bottom ash. Only lead and cadmium are normally leachable from the ash in quantities large enough to be of concern.

Currently, most United States facilities mix the fly and bottom ash before it enters a landfill[72]. The ash composition is so variable depending on what is being incinerated that toxicity tests are also extremely variable. The U.S. Congress is currently considering bills that would support ash monofills (constructed solely for municipal waste ash) or Subtitle C (hazardous waste) landfills for disposal of ash with regular municipal waste[73]. Presently, there are no Subtitle C landfills located in Minnesota, Wisconsin or the Upper Peninsula of Michigan[74]. Thus, although there is a substantial reduction in the volume of solid waste through incineration, the cost of disposing of its ash may be substantially higher per ton than municipal solid waste.

TRANSFER STATIONS

Transfer stations are solid waste facilities where transferring of solid waste from one vehicle or container to another, generally of larger capacity, occurs prior to transporting to the point of processing or disposal. Transfer stations appear to be the most pragmatic and immediate solution to the solid waste problems on Tribal lands in USEPA Region V. Most of the

Reservations generate small volumes of waste ranging from 0.1 to 10.0 tons per day[75]. The majority of the Tribes have very limited available finances and high unemployment rates. Most of the 66 dumps and landfills have less than satisfactory operation and frequently they have little or no maintenance[76]. Presently, numerous Tribes have already incorporated transfer stations into their solid waste program and other Tribes are developing plans or have expressed interest in implementing such a program.

Various types of transfer systems currently exist including: curbside pickup, scattered dumpster pickup stops or one main transfer station holding area on the Reservation. The type best suited for each Tribe depends primarily upon the population distribution on the Reservation. Two alternative plans will be discussed in this report.

For Reservations with distinct communities where the distance between these homes or communities is not very great, a curbside house-to-house pickup system is feasible. A color coded bag system where each individual must purchase specially marked bags for a preset cost per bag could be initiated to encourage recycling and resource recovery. In this system free clear bags are issued for recyclables and only the material one does not recycle is put in the specially marked bags. In this way recycling is strongly encouraged while solid waste disposal costs are simultaneously drastically cut. The cost of each bag helps pay the costs of operation. Such a system is to be implemented for a Winnebago community on October 1988[77].

For Reservations where the population is more dispersed, a series of dumpsters instead of curbside pickup may be more practical. Tribal members could then drive to the nearest dumpster location to dispose of their waste. The startup costs for the dumpster type transfer station is minimal (approximately $700 per dumpster and $500 per 12'x 12'x 6" concrete pad) and a structure with bin storage for recyclables could be built for a relatively small fee. At these centralized dumpster locations, a series of bulk bins for recyclable items such as newspaper, glass and aluminum could also be placed at these locations to encourage recycling. The Stockbridge-Munsee Reservation is currently attempting to fund a variation of this system which would use specially marked bags[78].

Financial difficulties have plagued some of the transfer stations currently operating on Tribal lands. At Bois Forte Reservation, the accounts receivable rate varies from 27% in winter to 85% in summer and at the Leech Lake Reservation the collection rates on accounts receivable are 30%[79]. At the Grand Portage Reservation, a new transfer system was begun the summer of 1988 which was structured to alleviate the financial burden on Tribal members[80]. The Tribe and Indian Health Service developed three comercial user rates so that the clinic, schools, and businesses, will have to pay higher rates which aids in reducing the residential users' rate to a reasonable $2.00 per month fee which may encourage more residents to pay their disposal fees.

A system where the Tribe pays for the entire reservation tipping fee and then redistributes this charge to the schools, clinic and businesses in such a way as to lessen the tipping fee

for residents. The decision of whether the Tribe wishes to operate the truck service will depend upon both the Tribes' willingness and ability to purchase, maintain and run the service. Although startup costs are much lower with transfer stations and the wastes are removed from the Reservation, this approach to solid waste disposal has one major disadvantage - the loss of final control over the finances of their waste disposal. If a single large monopoly owns and operates the only local landfill or waste hauling service, tipping fees may double or triple and the tribes have little recourse.

Guidelines and regulations are necessary for transfer stations. Storage containers should be durable, rust resistant, nonabsorbent, leak-proof, easy to clean and effectively contain solid waste. If putrescible waste is stored in the containers; there should be durable light-weight, close-fitting, fly-tight covers on the storage containers. These containers should be maintained in good condition, emptied at least once per week and the area around them should be kept sanitary and aesthetically pleasing. No burning of solid waste should be conducted and objects too large for the containers should be stored in a nuisance free manner. All weather access should be provided and maintained. The Menomenee Reservation is planning to construct a drive-up ramp so that Tribal members can just dump their waste into the canisters and do not have to lift their waste into a dumpster[81].

If the tribe is running its own collection and transportation service, the vehicles should be durable, clean, leak-proof and maintained in good repair. The solid waste should be loaded and moved in such a manner that the contents do not leak, spill or fall. All spills and litter should be properly cleaned up by the operator. The truck should transport wastes only to an approved sanitary landfill or incinerator. Asbestos, explosive, and hazardous wastes should not be accepted. The Tribe should have alternative methods formulated for the collection of these wastes.

HAZARDOUS WASTES

Twenty-nine potentially hazardous waste sites were located within or near to the exterior boundaries of the Tribal lands within USEPA Region V[82] and additional sites have been located by both the Indial Health Service and the Directors of Environmental Health for individual Tribes in the Region. These sites are listed and briefly described in Table I.

A Preliminary Assessment was done by the EPA on all 29 sites in which all available documents were reviewed and a risk factor was assigned to the site based on what population density would be affected. No additional monitoring was done for this site assessment, even on sites where there was no or very little documentation. Four of these sites are presently undergoing site inspections.

The Saint Regis Paper Company site at Leech Lake Reservation was declared a Superfund site and is presently being cleaned up. The Fort Howard Paper Company sewage lagoons site on the Oneida

TABLE 1: POTENTIAL HAZARDOUS WASTE SITES OF EPA REGION V WITHIN OR NEAR THE EXTERIOR BOUNDARIES OF TRIBAL LANDS

MINNESOTA

Fond du Lac Reservation

1) U.S. Gypsum Company (formerly Conwed Co.): placed barrels outside of the plant, buried in landfill on company land
2) Tribally owned steel processing plant: known to use xylene, caustic soda, phosphoric acid, hydraulic fluids. Sitings of liquid dumping. Volatile organic compounds and phosphorus detected in nearby wells.

Leech Lake Reservation

1) Site of old Burlington Northern Railroad
2) Old Cass Lake Town Dump: transformers' PCBs dumped. Pike Bay contaminated with PCBs. Fish contaminated with PCBs. High rate of cancer in people who live within a 3 mile radius of this site.
3) Leech Lake Sanitary Landfill: arsenic, mercury and VOCs detected in monitoring wells. Asbestos known to be dumped there.

Mille Lacs Reservation

1) Duxbury Pesticide Site: Minnesota DNR used this site in 1971 to dispose of pesticides which included lead arsenic, DDT, endrin, Aldrin and other pesticides. The site was allegedly cleaned up in half a day in 1984. Reservation questions the quality of the cleanup job.
2) Swamp just east of Reservation at Mille Lacs: midnight dumping of unknown barrels.

Nett Lake Reservation

1) Lead Arsenic Dump: cardboard boxes (lined in plastic) of lead arsenic dumped by Minnesota DNR between 1942 and 1944. Vegetation damage seen on aerial photos first indicated site. Site has been cleaned up by DNR, but unknown if completely cleaned up.

White Earth Reservation

1) Three airports on the Reservation where pesticides used for crop dusting may be dumped or spilled.
    a) Rosedale Twp., Sec.19
    b) White Earth Twp., Sec. 34
    c) Minerva Twp., Sec. 28
2) Two closed fiberglass factories
    a) Factory near Elbow Lake: wastes placed in Baily Dump. High concentrations of certain metals identified in soil and water samples taken by A.T.Kearney Inc.

Michigan

Hannahville Reservation

1) Dump in center of Sec. 36 Bark River Quadrangle: white petroleum product placed in dump allegedly from the K.I. Sawyer Air Force Base.

Isabella Reservation

1) Old Dow Chemical Plant: NE 1/4 of NE 1/4 Sec. 10, T14N R4W, unknown if materials were dumped in 1920's-1930's.
2) Roosevelt/Leonard Refinery: SW 1/4 of SW 1/4 Sec. 10 T14N R4W, used as a petroleum refinery until 1960's, now site used for a junkyard. Materials dumped from prior to 1930's to late 1960's. There were several explosions and fires at this site.
3) Ferro Company: NW 1/4 of NW 1/4 Sec. 15 T14N R4W, started as a porcelin factory, changed to an auto factory where trucks were produced and parts were galvanized. Galvanizing agents were dumped there until 5 years ago.
4) Gorham Factory: Oak Tree Village (312 S. Oak Street) was built over it.

Wisconsin

Bad River Reservation

1) American Can Disposal Site: sludge dumped from early 1960's to late 1970's. Approximately 40 acres used for dumping. Surface deposits supposedly removed. Some sludge also placed in trench and covered with clay. Surface water is discolored and flows into the Silver Creek.

Forest County Potawatomi Reservation

1) Connors's Saw Mill near Leona: wood treating chemicals in drums dumped, began in 1930's and unknown if still are dumping wastes. Trees dying near site.
2) Bocco Co. Gravel Pit: when pit no longer used for gravel, a plastic liner was placed in it and it was filled with an unknown material.

Lac Courte Oreilles Reservation

1) Louisiana Pacific Company: located adjacent to Reservation, cited by the DNR for contamination of air by arsenic.
2) Environmental Waste Service: storage area for hazardous waste, was not reissued a license by DNR, located north of Reservation on Chief River.
3) Old Omni Lab: electronics company operated this from 1960 to 1968, possible chemicals used in sodering, presently used as a youth center for the Reservation.
4) LCO Landfill: listed by DNR as a possible hazardous waste site.

Menominee Reservation

1) Trend Products Manufacturing: run by Minominee Tribal Enterprises, 40 barrels two thirds full of solid waste of polyester resin, organic peroxide (accelerator) lubrison were kept at site and are still there. One barrel exploded 2 years ago.
2) Keshena Dump: midnight dumping of foundry sand.

Oneida Reservation

1) Fort Howard Paper Co. Sludge Lagoons: proposed Superfund site.
2) Hobart Landfill: potential hazardous waste site, listed by WI DNR.
3) Brown County West Landfill: Potential hazardous waste site, listed by WI DNR and on CERCLIS.
4) Walter Kodke Dump: listed by WI DNR.
5) Nelson, Ninham, Ness: demolition and domestic garbage (active) listed by WI DNR.
6) Damrow Dump: listed by WI DNR and on CERCLIS. BIA did a PA in 1986 and found it was not hazardous.
7) Schauman Dump: listed by WI DNR
8) Adrian/Glenn Dump: listed by WI DNR.
9) Old Oneida Landfill: listed by WI DNR and on CERCLIS. Site inspection done by EPA.
10) Appleton Garage: tire dump, fire occurred here, tires since removed.

Mole Lake Reservation

1) Old Nashville Dump: barrels of unknown liquids and old car batteries dumped there between 1973 to present.
2) Connor's Forest Industrial Disposal Pits: several sites around the Reservation, was a wood treatment company near Leona, disposal sites are around the Crandon area.

Stockbridge-Munsee Reservation

1) Old Morgan Dump: barrels of unknown material placed in it, tires, fertilizers and pesticides used in the 1930's to control grasshoppers. Dumping from ? to 1960. Town of Morgan and Bob Kristoferson responsible for the dumping. A PA was done on this site. High cancer rate in the town of Morgan. This town has a high concentration of nitrate in the drinking water, source unknown.

Reservation was proposed in June 1988 to be put on the National Priorities List for Superfund cleanup. The other 23 sites need further investigation to obtain more specific information on whether dangerous material dumping has occurred. Sites found by the Indian Health Service and Tribal Health Directors found should also be investigated. If additional evidence indicates that health threats are present, then monitoring wells should be installed at these sites. Water and soil samples should be analysed to examine what environmental damage may have taken place. Long term monitoring may be necessary at some sites.

Hazardous waste exchanges may aid companies on or near Tribal lands that are small generators of hazardous wastes (generate between 100 to 1000 kilograms per month of hazardous waste). These exchanges are information clearinghouses or brokerage type exchanges that help companies identify waste management options such as locating other firms that may wish to reuse or recycle a specific waste product[83].

Conventional cleaning products often contain lye, formaldehyde, chlorine, harmful solvents and other corrosive or nerve-deadening agents. These hazardous substances pose the greatest threat of personal injury, not just from the specific cases of poisonings from ingestion of these products by children, but also from skin contact and inhalation over a period of years. For example, mothballs and toilet bowl deodorizers contain naphthalene, which is toxic by inhalation. Safer household items can be substituted for many more toxic commercial cleaners and be equally affective. Baking soda, borax, lemon, distilled white vinegar, rubbing alcohol, hydrogen peroxide, pure liquid soap and table salt are just a few of these safer cleaners. More extensive lists and recipes for safer cleaners are available at State resource recovery offices, or in practical environmental journals, and old home ecomonics texts[84].

Many of these household hazardous products should not be put down the drain as sewage treatment plants and septic systems can not decompose the toxic elements in the waste water. Household hazardous wastes can also contribute to groundwater contamination at solid waste disposal sites. Although household hazardous wastes make up less than 1% of all residential wastes[85], the average household contains between three and ten gallons of hazardous materials such as paints, aerosols, kitchen cleaners, polishers, pesticides and automotive products[86]. Educational programs and additional information on household hazardous waste reduction should be made available to the Tribal members. When these substances are disposed of in landfills, they can corrode through landfill linings and contaminate gooundwater, lakes and streams; and some solvents will pollute the air. Many communities have developed household hazardous waste collection programs. As of November 1986, 530 community programs have been held in 33 States[87]. The goals of such programs have been:

1) Increase public awareness of household hazardous materials and how these substances impact human health and the environment.
2) Educate residents as to the best way to dispose of

household hazardous materials.
3) Reduce health risks to sanitation workers.
4) Remove the materials from homes, to reduce occupant exposure and potential injury.
5) Provide proper household toxic chemical disposal.

These programs have been expensive ($2 to $9 per pound of hazardous waste collected), so sponcers must be found if the service is to be free of charge to encourage participation[88]. Program success can be boosted by adequate promotion, proper site location (a place known to residents and easily accessible like a highschool parking lot) and through training of the site personel. Local hazardous waste exchange centers where paints, paint thinners and other materials can be deposited where others can take and use these leftover products free of charge may also be a viable option for household hazardous waste reduction and could be done in conjunction with a "clean-sweep" hazardous waste collection day.

Although household hazardous wastes represent only a small fraction of the total volume of hazardous wastes produced in this country, it is desirable to avoid having any hazardous waste contamination of the environment. Through publicity, education programs and community collection or redistribution programs, Tribal members can become more aware of the importance for special handling and disposal of hazardous wastes on both a household and industrial scale and they can actively participate in caring for their environment.

ROLES FOR FEDERAL GOVERNMENT AGENCIES

INTRODUCTION

An appropriate system of solid waste management will not emerge on Tribal lands without some assistance from the government. This assistance should be a coordinated effort among the Federal Agencies involved and the Tribal governments. A Memorandum of Understanding (MOU) was agreed to by the Environmental Protection Agency (EPA), the Indian Health Service (IHS), the Bureau of Indian Affairs (BIA), the U.S. Geological Survey (USGS), and the Department of Housing and Urban Development, Office of Indian Programs (DHUD,OIP) in February 1988 to coordinate environmental programs affecting Indian lands in USEPA Region V. Cooperative efforts in planning, training, funding, needs assessments, technical assistance and information exchange are better able to address the Tribes' solid waste needs and prevent conflicting or redundant efforts being made by multiple Federal Agencies.

It is also important that the development of Tribal solid waste policies should parallel the development for the management of air, groundwater, surface water and drinking water. Without parallel development, there is the risk that poor controls and regulations on solid waste will lead to increased pollution in these other media despite their regulations[89]. Additionally, some Tribal lands have become a target for toxic waste dumping by

some of the nation's largest waste management corporations and industries and frequently tempt impoverished Tribes with huge profits[90]. Thus it is important to promptly develop and implement solid waste management plans, guidelines and regulations on Tribal lands.

A statutory change in the definition of Tribes under RCRA Subtitle D would help facilitate the development of solid waste plans on Tribal lands. The present definition of Tribes as municipalities needs to be altered so that Tribes can be treated as equals to States. This will allow the Tribes to have the same previleges and responsibilities for the development and implementation of a solid waste plan. It would entitle them to better access to funding sources such as Community Block Grants and technical assistance. It should also help to clarify jurisdiction rights for Subtitle D issues. Pros and cons of this statutory change are presented in a recent EPA report[91]. RCRA Subtitle D should be altered so that the major decision making on solid waste management is open to the Tribes in a clearly defined manner and bolstered with both technical and financial support from coordinated Federal Agencies.

BUREAU OF INDIAN AFFAIRS (BIA)

The Bureau of Indian Affairs (BIA) is under the Federal Trust Responsibility that requires that the United States act in the best interest of the beneficiary Tribes to promote Tribal self-government and to protect Tribal lands and Sovereignity[92]. The environmental quality of these Trust lands must be protected through the authority of the National Environmental Policy Act (1969). These protections include the development of an Environmental Impact Statement (EIS) for every major Federal action which significantly affects the quality of the Tribes' human environment. The BIA can provide technical assistance and money for both corrective measures and start-up solid waste projects. The BIA is planning to hire an area level hydrogeologist for the EPA Region V[93]. This person could aid the Tribes in compiling and interpreting background information for new solid waste site locations or for existing dumps or potential hazardous waste sites.

Monetary assistance is also available for solid waste projects. The Oneida Reservation has already received some financial assistance from the BIA. To promote financial assistance for solid waste projects, the Tribes must actively earmark money in their BIA budget plans and they should also lobby for money in this area when they speak before the Senate Select Committee on Indian Affairs and the House Committee on Interior and Insular Affairs in Washington D.C. In this way, specific money can be budgeted for solid waste issues. Congress must be informed by the Tribes that solid waste is a pressing issue and deserves to be funded.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

The Environmental Protection Agency (EPA) should promote changes to RCRA Subtitle D so that Tribes could be treated as equal to States. This would facilitate other avenues of assistance desparately needed by the Tribes. The EPA should provide both technical assistance and training to the Tribes for solid waste issues. It should also help them to develop suitable, environmentally sound solid waste guidelines and regulations for new and existing facilities, and should aid Tribes in funding remedial solutions for areas contaminated by solid wastes.

The EPA should also assist the Tribes in obtaining planning, training and pilot project money. The EPA budget for Indians should be broken out of the HUD and Independent Agencies Appropriations Committee and be routed through the Senate Select Committee on Indian Affairs and the House Committee on Interior and Insular Affairs as it is for IHS, BIA, and DHUD,OIP. This would give the Tribes more leverage to obtain funds and streamline the process for funding Tribes. The EPA should help the Tribes apply for grants and other monies such as Community Development Block Grants. It should also help them obtain GSA surplus equipment that would be useful for solid waste programs. The EPA should be the Federal Agency with primary enforcement authority of solid waste RCRA statutes. However, the Tribes must also promote enforcement of its regulations for a successful solid waste plan. Preventive measures for environmental protection should be stressed by the EPA so that the Agency will not be forced to be continually occupied by crisises.

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT, OFFICE OF INDIAN PROGRAMS (DHUD,OIP)

Presently, the Department of Housing and Urban Development, Office of Indian Programs (DHUD,OIP) has a Memorandum of Agreement (MOA) with the Tribal Housing Authority pursuant to an Interdepartmental Agreement on Indian Housing (24 CRF Part 905, Subpt. B, Appendix I, 1983) to have the IHS construct the water and sewage facilities, but it fails to mention solid waste facilities. In USEPA Region V however, DHUD,OIP is providing solid waste services at some of its communities but not at others[94]. DHUD,OIP should recommit itself to providing solid waste facilities to its preexisting and new homes. It should aid in both financial and technical assistance and act to fulfill its Trust responsibilities. It should also financially assist in the closure and monitoring or cleanup costs of old dump sites where DHUD households or facilities were partially responsible for the waste deposition.

INDIAN HEALTH SERVICE (IHS)

Indian Health Service (IHS) is enabled to provide and construct essential sanitation facilities, including solid waste facilities, for Indian and Alaska Native homes and communities by Public Law 86-121 and delegations of authority issued by the Secretary of Health and Human Services. These projects are carried

out as a cooperative effort with the people to be served by the completed services on a government-to-government basis.

During the past three decades, IHS has been the major Federal Agency contributor of both technical assistance and financial aid for solid waste facilities on Tribal lands. In USEPA Region V, it is currently helping multiple Tribes to develop and finance transfer stations[95]. IHS should continue these efforts in helping Tribes develop and implement waste management plans. IHS should also technically advise and help train Tribal sanitarians and other Tribal members so as to encourage and develop in them the knowledge and capability to operate and maintain these solid waste facilities in a safe and effective manner. The Tribes and not IHS must operate and maintain these facilities; although, IHS can assist them plan, design, construct solid waste facilities and train facility operators.

IHS can also assist in the closure of old Tribal dump sites. It can help provide both financial and technical help and because of the sundry problems at some of these allegedly closed sites[96], IHS may wish to be present to supervise the closure in its multiple phases to ensure a proper closure. The IHS frequently coordinates multi-agency funding for these facilities. It should continue to pursue these flexible funding arrangements with many different sources.

UNITED STATES GEOLOGICAL SURVEY (USGS)

The statutory definition of the United States Geological Survey (USGS) and its mission, including the Organic Act of 1879 and subsequent annual Appropriations Act, state that the USGS is to provide technical assistance in the area of surface water and groundwater. As a natural resource research and investigation agency, it is responsible for developing basic scientific information on water resources.

The USGS has installed and is monitoring numerous wells around existing open dumps and potential hazardous waste sites in USEPA Region V on Tribal lands. Many of these are recent efforts[97,98]. The USGS should continue and expand these efforts, and should assist the Tribes in gathering and checking background geologic, hydrogeologic and soils information for the existing sites located on Tribal lands. When the EPA did the Preliminary Assessment (PA) on the 29 potential hazardous waste sites, only the existing documentation and population density of the area were taken into account to determine if the site was hazardous. The 23 sites that were deemed non-hazardous may be defined in this manner because there were no existing documents on the dump (highly probable) or few people live within a certain radius of it (also highly probable). The USGS can provide an invaluable service to the Tribes by aiding them in monitoring and documenting the resource characteristics at these sites. The USGS efforts to fill information gaps will tremendously aid the Tribes in making wise assessments of their environmental problems due to solid waste. Finally, the USGS can also provide valuble information to the Tribes for siting new solid waste facilities.

CONCLUSIONS

The ultimate goals of solid waste management should be to conserve resources and find solutions or methods of disposal which protect human health and the environment. Solid waste management is presently not cheap and it is rapidly becoming more expensive due to tighter environmental regulations and decreasing siting space. It represents a net cost which can be minimized by better operations and appropriate recycling and resource recovery. The Tribes should encourage processes and activities that produce the lowest amount of total waste and the least amount of hazardous and nonrecyclable wastes. All feasible and reasonable steps should be taken to reclaim materials from the waste, by reuse, recycling or reclamation of the waste to a useable product. Thus waste prevention measures should be the primary focus for the Tribes' solid waste plans. This will decrease the disposal costs, save valuble resources, provide recycling profits, and help protect the environment from potential air and water contamination.

The 66 existing dumps on Tribal lands in USEPA Region V need to be properly closed. However, if the situation dictates that they must remain open until better alternatives are developed, then they should be regulated and operated in an environmentally sound manner. New arrangements must be made for the disposal of wastes from the currently operating Tribal dumps. Properly sited, designed and operated sanitary landfills and incinerators should be the depository for these wastes. Many Tribes will probably opt for transfer stations and have their wastes hauled off the Reservations due to financial constraints. No matter which method is used, the Tribes must take the responsibility to educate themselves in solid waste disposal alternatives and to ensure that their wastes are disposed of in ways that reduce the level of risk to public health, water supplies and the environment. Development of solid waste plans, guidelines and regulations need to be developed and enforced. Waste generators, especially businesses within the Reservation, should be held responsible for their wastes.

The 29 potentially hazardous waste sites and other potentially health threatening sites found by the IHS or Tribal Health Directors should be more throughly investigated and monitored. Remedial cleanup should be done in areas where human health or the environment are threatened.

The BIA, EPA, DHUD-OIP, USGS, and IHS all have technical and financial responsibilities to the Tribes for solid waste management. These duties should be implemented by the agencies in a coordinated and responsible fashion. The alteration of the definition of Tribes as municipalities to an equal of States in RCRA Subtitle D will promote the development of better solid waste management on Tribal lands.

Waste management is not only a technical problem, but it is also strongly influenced by cultural, social and economic circumstances on Tribal lands[99,100]. Ultimately only the Tribal members can solve the solid waste management problems on their

- Reservations. Environmentally sound solid waste facilities are only as good as their operation. Tribal leaders should stress the financial, health, and environmental advantages of wise solid waste practices. They should focus on preventive waste measures and insist that wastes be minimized and disposed of in an environmentally sound way.

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